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Some points in the Surgery of
the Knee-joint with special
reference to the Semilunar
Cartilages.

A LECTURE DELIVERED BY

A. G. TIMBRELL FISHER, M.C.,
F.R.C.S. (Eng.)

to the Members of the Medical Practitioners' Union,
at 56, Russell Square, London, W.C.1.



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A. G. TIMBRELL FISHER, M.C., F.R.C.S. (Eng.)
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Mr. Chairman, Ladies and Gentlemen,

I must first of all thank the Council of the Medical Practitioners' Union for honouring me with the invitation to deliver this lecture. The subject that I have chosen for my lecture is some common disorders of the knee-joint ; their diagnosis and treatment ; with special reference to the surgery of the semilunar cartilages. I thought that this might prove a suitable subject for two principle reasons. Firstly, because many of them are of almost daily occurrence in practice ; secondly, because their diagnosis often proves a very difficult problem. At the same time I must crave your indulgence in the difficulty which faces me of endeavouring to do justice to such a large subject in the short space at my disposal.

One of the principal difficulties with which we are faced in dealing with any disability of the knee-joint is that there are a host of different conditions which may give rise to signs and symptoms which at first-sight resemble each other somewhat closely. One guiding principal in attacking a difficult problem of this nature must be a thorough and painstaking investigation, not only of the joint itself but of the history, which when given by an intelligent patient, may be of great value. In examining the joint the state of every component part, bone, cartilage, ligament, synovial membrane, and fluid must be investigated ; the condition of the extra-articular structures, particularly bursae, the presence or absence of muscular

wasting or deformity, the range of movement, whether it is painful or painless and whether any movement is limited or excessive. Finally, an X-ray examination in two planes, comparison being made if possible with the opposite side, may clinch the diagnosis in a difficult case. Over-confidence is fatal. Unless one acquires the habit of thorough investigation on these lines, even the most experienced will make serious blunders.

In most of the conditions to be described there are certain signs and symptoms which are common to nearly all, but there are others which are more characteristic of the different conditions, which we shall attempt to emphasize. In nearly all of these conditions recurrent synovial effusions occur and wasting of the extensor muscles of the thigh, particularly involving the vastus internus. Furthermore, there is often a complaint of weakness and unreliability of the knee with occasional "giving-way" of the limb. The special points will be discussed under the individual headings. In every case of recurrent synovial effusion it therefore behoves us not to rest content to label a case "synovitis," but to use every effort to ascertain the cause of the synovitis, whether mechanical or due to some constitutional disturbance, infection or toxæmia. In some cases we shall be baffled and in some of these exploratory arthrotomy may be indicated.

Time will not permit me to deal with the fascinating subject of the pathology of the various conditions of the knee-joint except in the most cursory fashion. I propose to discuss sprains particularly of the internal lateral ligament, loose bodies lesions of the semilunar cartilages, crucial ligaments, infrapatellar pad of fat and tibial spine, and adhesions in the knee. I propose first of all to say a few words about *sprains of the knee*. The knee-joint is of course one which, unlike such joints as the hip, elbow, or ankle, depends for its stability very little upon the actual shape of the articulating surfaces but owes its strength principally to the ligaments, tendons, and muscles which are in relation to the joint. It is obvious therefore, that sprains of the knee are very frequently encountered. They may involve any of the ligamentous or tendinous structures and vary from those that are trivial and unassociated with synovial effusion to more serious forms of injury, almost invariably associated with

such synovial effusion. As the internal lateral ligament is most frequently involved, I propose to select sprain of this ligament for discussion and much that will be said about the diagnosis and treatment of this form of sprain applies also to other varieties of sprain. The internal lateral ligament consists of a long anterior or superficial and a shorter posterior or deep portion. Injury to the former usually involves the upper attachment whereas injury to the posterior or deep portion usually involves the lower attachment to the tibia, near the middle of the inner border of the internal semilunar cartilage. The mechanism of production is interesting and important. It is usually as follows : the foot being planted firmly on the ground the thigh is forcibly rotated inwards and the inner side of the joint is opened up owing to abduction of the leg. If abduction is more marked than rotation the brunt of the injury falls upon the long portion of the internal lateral ligament. If rotation is more marked than abduction, then the deep fibres of the internal lateral ligament are usually involved, and in these cases there is a particular tendency for an associated fracture-dislocation of the internal semilunar cartilage to occur. In severe cases, if the rotatory force continues to act, the anterior crucial ligament may be stretched or torn or the tibial spine avulsed.

Symptoms.—Vary with the nature and extent of the injury. Severe pain is experienced in the joint, more marked on the inner side. In marked cases swelling occurs at once not only at the site of the injured ligament but into the joint. In these cases the effusion is largely haemorrhagic ; in slight cases swelling may not be apparent for several hours. Actual mechanical locking is absent in uncomplicated injury to the ligament, whereas in fracture-dislocation of the internal semilunar cartilage this sign is frequently present. In injury to the long portion of the ligament tenderness is usually present, over the upper attachment and in injuries of the deep fibres, tenderness is present at their lower attachment to the head of the tibia. This is also the diagnostic point of tenderness in the commonest lesion of the internal semilunar cartilage so that the mere position of maximum tenderness does not assist us in diagnosis. The general treatment of such sprains, and the prevention of adhesions resulting from synovitis following a sprain of a lateral ligament, can be

summed up in a few words, viz , “ Rest from all undue strain of the damaged ligament combined with early movement of the joint.” At first sight this maxim may seem contradictory, but in reality this is not the case. Rest from weight-bearing and excessive use permits healing to proceed, but early movements, at first of but short duration, prevent the formation of adhesions. The principle of early movement, admirable though it be, is not sufficient, for unless we aim at early movement *through its full range*, adhesions may yet develop and give rise to much subsequent trouble.

Let us attempt to illustrate the principle of the prevention of adhesions by a concrete example. Rest in bed or on a couch is enjoined at first. This is combined with a firm compression bandage over a thick layer of wool, which should completely surround the joint and extend for some little way upwards into the thigh and downwards into the leg. No splint should ever be used, but the joint slightly flexed over a pillow, for experience has shown this to be the position of greatest ease. Rest from weight-bearing must be enjoined as long as the synovial effusion persists. From the very first the bandage is removed daily and gentle massage (*effleurage*), electrical stimulation of the quadriceps, and movements may be instituted, for these, added to the elastic compression, play an important part in the absorption of the intra-articular effusion and prevent muscular wasting. Each day the movements are increased. In about a week in marked cases, or considerably less in minor cases, effusion will have subsided, and it should be our aim to have obtained full movements by this time.

There is now no objection to weight-bearing, provided strain upon the recently damaged ligament be eliminated, and this can usually be ensured by the simple device of reinforcing the inner sides of the sole and heel by a wedge-shaped piece of leather $\frac{1}{4}$ -in. in thickness, or in severe cases rotation and abduction may be prevented by the temporary use of a knee-cage which permits flexion and extension. For a short period, and especially if there is any tendency to swelling occurring after exercise, a compression bandage should be worn during the day. This, however, should be dispensed with as soon as possible, as it tends to interfere with the development of the thigh muscles. As this swelling is often due to loss of

tone of the thigh muscles, every effort should be made to remedy this by re-education.

Treatment of Chronic Cases.—In many of these cases we are faced with a set of conditions constituting a vicious circle. The sprain has given rise to synovitis ; this causes reflex wasting of the thigh, and the resulting laxity of the capsule still further predisposes to minor traumata of the synovial membrane and delayed absorption of synovial fluid. In this group lateral mobility is usually present.

The first principle of treatment in this type of case is to endeavour by exercise and electrical stimulation to improve the tone of the quadriceps and avoid strain on the inner side of the joint by the alteration in the shoes already mentioned. The lateral mobility can often be considerably lessened in this way. In cases where a more severe rupture has occurred and where lateral play is marked, these measures are not in themselves sufficient and operation may be advisable to shorten the relaxed internal part of the capsule. Failing this a knee-cage may have to be worn permanently. It should be pointed out that in some cases slight limitation of flexion is present and tenderness over the internal lateral ligament rather than lateral mobility. This tenderness over the internal lateral ligament is due to the presence of scar tissue, which may be present not only in the ligament itself, but in the synovial membrane lining its deep surface which, indeed, may be adherent to the scar. Now this scar tissue when stretched gives rise to a sensation of acute pain and a reaction in the joint, and hence the recurrent attacks of pain and effusion after exercise. The presence of scar tissue in excess is the *fons et origo* of the group of symptoms, and the great principle of treatment is to deal with this and subsequently to concentrate upon the treatment of the resulting and concomitant conditions. The latter are sufficient in themselves to give rise to serious trouble and a continuance of symptoms after the internal lateral ligament has ceased to be a source of trouble *per se*. The ideal treatment of the original lesion, as we have seen, is so to direct Nature's efforts that the scar formed is not in excess—neither should it cause any interference with movement, but neither should it be unduly stretched. By early movements there can be no doubt that we may prevent the adhesion of the synovial membrane to the scar in the

internal lateral ligament. When adhesions have actually developed which persist after a fair trial has been given of gymnastic exercises, the vicious circle may be broken by manipulation. In some slight cases this measure is all that is necessary, but in neglected cases the after-treatment is of great importance and must follow two important lines :—

(1) The increased range of movement obtained by manipulation must be preserved, and the ground gained consolidated by the patient voluntarily exercising the joint through the increased range of regular intervals, commencing almost immediately.

(2) The wasted thigh muscles must be made to recover their tone and bulk by re-education. It will be then noted that the lateral mobility hitherto present will usually disappear. In some minor cases the adhesions may be gradually stretched and full movement restored by gymnastic exercises ; this process is, however, longer, more tedious, and less reliable than manipulation under anaesthesia.

Lesions of the Semilunar Cartilages.

Before discussing the diagnosis and treatment of these lesions it must be mentioned first of all that the term “ displaced semilunar cartilage ” that we so often hear is a misnomer, or rather of the nature of a half-truth, for by far the commonest lesion found is a *fracture-dislocation*. The most frequently encountered form of injury is a longitudinal tear involving the whole length of the cartilage except its anterior and posterior extremities. Rutherford Morison has called this the “ bucket-handle ” type of injury. Injuries to the external semilunar occur in about 5 per cent. of cases. Time will not permit of a detailed consideration of the exact mode of causation. Briefly the position of the limb is very similar to that which brings about a tear of the deep fibres of the internal lateral ligament except that the coronary fibres by which the cartilage is attached to the tibial condyle are torn, the cartilage is displaced towards the interior of the joint, and before it can get back is—as it were—ground between the internal femoral and tibial condyles.

There is a certain similarity in the symptoms also, except that in a cartilage lesion, mechanical locking frequently occurs. In a few

cases, the locking temporary, but in this type recurrent attacks are apt to be associated with mechanical locking of a more definite nature.

We are all familiar with the advice of Sir George Humphry : “ Eyes first and much, hands next but little, tongue not at all.” Nevertheless, in the diagnosis of semilunar lesion, both original and recurrent, the history as given by an intelligent patient is of considerable importance ; the symptoms are in fact so dramatic that as a rule, they make an indelible impression upon the patient’s mind. In recurrent cases between attacks a definite history may be of even greater importance than the physical signs which may be negligible. From the point of view of symptomatology cases of semilunar derangement may be divided into two principal classes :—

(1) In the first class, the symptoms are severe at first and recurrences usually tend to become more frequent but are associated with less reaction.

(2) In the second class, symptoms are slight at first but gradually become more marked until definite locking occurs, thus simulating the original onset of the first class and followed by a similar sequence of events.

In the first and most usual class, the usual history given is that of a twist associated with abduction as already mentioned. The patient experiences severe pain on either the inner or the outer side of the joint and may fall to the ground. He notices almost immediately that although he can flex the knee yet there is a mechanical block to full extension which is limited by 10 or 20 degrees. In some cases of injury to the posterior horn flexion may be similarly restricted. Synovial effusion ere long manifests itself. Tenderness is nearly always marked in the case of the internal semilunar cartilage opposite the middle of its inner surface. I believe tenderness at this spot to be much more common than the spot commonly described on the inner border of the tibia to the inner side of the ligamentum patellae.

In the second class of case there is usually a history of recurrent effusions, or attacks of “ giving-way ” of the knee before true locking occurs.

Treatment.—In the first place the displaced portion of the cartilage must be made to retrace its steps by manipulation at the earliest possible moment. Although not absolutely essential, an anaesthetic is advisable to abolish pain and muscular spasm. Nitrous oxide if skilfully given produces adequate relaxation, although in an obstinate case longer relaxation such as may be obtained by gas and oxygen or chloroform and ether may be indicated.

The patient preferably lies upon his back upon a couch. The knee is first fully flexed and then while maintaining abduction at the knee, the leg is rotated inwards and outwards as one passes from flexion to extension. It is during the rotary movement that the displaced portion of cartilage slips back into place often with an audible snap. Many efforts fail through not opening up the inner side of the joint sufficiently. The manipulation ends with firm extension, not forgetting the final “screw-home” movement at the end of extension whereby the displaced portion is firmly forced home.

The test of reduction lies in the fact that the patient can himself fully and painlessly extend the knee. The patient himself is often the best judge as to the success or otherwise of the manipulation.

After-Treatment.—Repair in the semilunar cartilages is very sluggish and if we were to immobilise the knee until we felt convinced that union had occurred, such a long period would have to elapse, that many undesirable consequences would follow, such as very marked wasting of the thigh muscles and the formation of adhesions with resulting crippledom. If the displacement is satisfactorily reduced it is probable that gentle exercise actually assists rather than impedes union. It may be treated therefore on very similar lines to a severe sprain and gentle exercise permitted as soon as synovial effusion has subsided provided of course that rotatory movements are avoided religiously. Personally, I never use a splint, Scott's dressing, strapping, plaster in these cases. Strenuous games must be avoided for six to eight weeks after reduction.

Recurrent Cases.—In the recurrent cases there will be a history of attacks of giving-way of the knee, often associated with definite mechanical locking ; each attack being followed as a rule by synovial

effusion. Wasting of the quadriceps particularly involving the vastus internus is frequently present, and often some lateral mobility due to frequent stretching of the capsule by the synovial effusions. Tenderness is present usually over the middle of the inner surface of the internal semilunar or occasionally over its back part. In some cases the fractured portion can be felt on flexion and extension of the joint, and in others a crack or snap or characteristic "rumble" can be heard during these movements.

An antero-posterior radiogram if a soft tube is used often shows a circular shadow in the region of the tibial spine or lying between the two tubercles of the latter which is the displaced "handle of the bucket." Occasionally, although everything points to a lesion of the internal semilunar cartilage, it is really the external cartilage that is at fault. An example of this occurred in my practice yesterday. I opened the knee-joint in a footballer who had the classical symptoms of a fracture-dislocation of the internal semilunar and to my great surprise found a torn and displaced external cartilage. There is another experience that may happen to the most experienced, that is, to find no lesion of the cartilage at all. With experience such an occurrence happens less and less, but does occasionally even when experience is considerable.

In the cases in which symptoms have become recurrent, operation findings show that in most cases the handle of the bucket lies in the intercondylar interval. It may lie in this situation without restricting extension and there is reason to believe that in many cases that have been treated by manipulation the locking had been reduced only by forcing the fractured portion still further into the interior of the joint. In such recurrent cases, unless the condition is of very long standing and happens very frequently, it is well worth while having recourse to manipulation, at any rate as a preliminary measure, or in persons who decline an open operation. The reduction is more difficult but the actual technique does not differ in any material respect from that already described. In some cases the attacks disappear for some time only to reappear and in these there should be no hesitation in advising removal of the offending cartilage.

The wearing of a knee-cage, which permits flexion and extension, but prevents rotation, sometimes prevents the attacks of giving-way or locking of the knee, but in my experience, apparatus of this sort is most unreliable and very burdensome to the patient ; furthermore, the torn cartilage persists and may give rise to osteo-arthritis of the joint. Therefore, unless there be some definite factor contra-indicating operation, the latter should usually be advised.

The question arises " Which is the best form of operation ? " I have no hesitation in saying that removal of the greater portion of the torn cartilage is attended with the best results. Most experienced surgeons have abandoned the older operation of stitching the displaced cartilage in position as in most cases the cartilage is torn as well as displaced, and recurrence after suturing the cartilage was very commonly encountered.

Removal of the torn cartilage in experienced hands and with proper technique and detailed attention to not only the after-treatment but the preliminaries of the operation, should be one of the most satisfactory in its results in the whole realm of surgery. Time will not permit me to describe in detail the stages and technique of the operation. I therefore propose to deal shortly with a few points that appear to me of importance and are not emphasised as a rule in textbooks of surgery :—

(a) Needless to say, the operation should never be performed except under the most perfect conditions of asepsis. At nursing homes and hospitals the operation should come first on the list to avoid the danger of a previous case turning out to be septic, and clean knee cases should not be awarded with septic cases for obvious reasons.

(b) In the preliminary preparation the whole limb must be shaved and prepared from Poupart's ligament to the toes, and protected by sterile towels. If carefully done, this can usually be left till the day previous to operation.

(c) *Use of the Tourniquet.*—I regard this as a valuable adjunct. It brings about a perfectly clean operation field and thus facilitates what is never an easy operation enormously. It should

be sterilised by boiling. The best type of tourniquet is the "anchor" pattern with the addition of a transverse handle behind the anchor. If the tourniquet is not put on properly (and there are quite a number of people who cannot put on a tourniquet), bleeding is extremely troublesome. The best plan is for the surgeon himself to put on the tourniquet—and before his final "scrub up." The tourniquet is not removed until the final bandages are in position. Finally take a last look before the patient leaves that the tourniquet has really been removed. I have heard of a case where the tourniquet was left on for some considerable time with disastrous results. It is sometimes stated that post-operative haemarthrosis is more common after the tourniquet has been used, but in my experience the exact opposite is the case.

(d) By far the best view of the cartilage is obtained when the leg is flexed to an angle of 90 degrees with the thigh.

(e) For a straightforward cartilage case a curved incision, about $1\frac{1}{2}$ ins. long, will suffice. The incision lies over the antero-internal or antero-external aspect of the joint as the case may be ; runs downward parallel and just in front of the corresponding lateral ligament, and then curves forwards. The lateral ligaments must never be divided and care must be taken during removal of the cartilage not to injure them.

(f) With regard to the question "Should the whole cartilage be removed?" This depends upon the type of injury present.

In cases of injury to the posterior horn it is advisable to remove the whole cartilage.

Where the anterior horn alone is torn or displaced, it is sufficient to remove the anterior two-thirds of the cartilage and leave the extreme posterior end, but one must be careful not to pull upon the cartilage and displace the back part while doing so. In the common "bucket-handle" lesion the anterior two-thirds of both portions should be removed.

(g) One should always exercise the utmost gentleness. There must be no pulling upon the edges of the wound, the articular cartilage must not be damaged and last, but by no means least, the finger should never be introduced into the joint.

(h) It is unnecessary to use a splint after the operation, the knee being rested upon pillows in the slightly flexed position.

(i) After treatment is of great importance. Our aim must be to start movements as early as possible to minimise muscular wasting. Massage of thigh and leg is instituted from the first. I usually instruct my patients to commence contracting the quadriceps muscle the day following the operation. On the third day they are allowed to bend the knee a few degrees inside the bandages and can sit on a couch.

On the seventh day stitches are removed; flexion should be possible to a right-angle and the patient can be allowed to walk a little.

On the tenth-fourteenth day the patient should be able to leave the nursing home with full movement in the joint and walking without a limp.

Exercises should be religiously and daily performed to develop the thigh muscles—especially the quadriceps extensor, of which the vastus internus usually needs most attention.

With the careful attention to all the many points mentioned, the operation of removal of the torn semilunar cartilage should be one of the most satisfactory in surgery. For instance, a professional footballer should be able to play as well as ever.

Differential Diagnosis.

We have already referred to the difficulty in diagnosing this condition from sprain of the internal lateral ligament. Let us therefore pass on to some of the other conditions of the knee-joint that may simulate a lesion of a semilunar cartilage.

Loose Body.—The type of loose body which is apt to somewhat closely simulate a semilunar cartilage lesion is that which is gradually exfoliated from the articular surface after an injury to the latter usually of the nature of a contusion. The joint is otherwise normal and not as in many of the other types the seat of pathological changes such as osteo-arthritis.

The classical symptoms of loose body is a sudden attack of severe pain often accompanied by a sensation of giving-way of the joint. Actual mechanical locking, if it occurs, is usually of a momentary nature. As in many other forms of internal derangement, recurrent synovial effusions occur and wasting of the quadriceps, particularly involving the vastus internus, may be present. Helpful points in diagnosis are :—

(1) The symptoms and signs are not necessarily localised to the region of a semilunar cartilage but many involve other regions which may vary from time to time.

(2) Tenderness is absent at the diagnostic points for the latter.

(3) The surgeon may be able to feel the loose body or the patient may come armed with a clear history of its presence.

(4) X-ray examination, which should always include antero-posterior, and lateral views, usually clinches the diagnosis, but may not reveal a body formed of cartilage only.

Enlargement of the Infra-Patellar Pad of Fat.

In this condition which may be either traumatic or an early symptom of chronic non-tuberculous arthritis, the pad can usually be felt to be obviously enlarged and to project on either side of the patellar ligament. It is obviously tender and complete extension may cause acute pain owing to compression of the semilunar processes of the pad. The sub-crureus muscle normally pulls upwards the pad of fat during extension and prevents it becoming nipped between femur and tibia. If the extensor muscles have become atrophied from disuse or disease the pad of fat is still more liable to be damaged in this way and a vicious circle results. The patient complains of pain behind the patellar ligament and there is a certain amount of stiffness and weakness after exercise. Recurrent effusions may occur and a sudden stabbing pain, or sensation of giving-way of the joint not amounting to true locking. In some cases X-ray examination may reveal the enlargement.

Treatment.—Local measures such as radiant heat, massage, and ionisation combined with exercises and electrical stimulation

of the quadriceps may effect a cure in cases of ordinary severity. If the pad is fibrous or calcified and resists local treatment its removal is indicated. I have found manipulation valuable in certain cases.

Rupture of a Crucial Ligament.

The crucial ligaments are a most important bond of union in the knee, and so great is their strength that true dislocation of the knee in which both crucial ligaments must of necessity be ruptured is a rare dislocation.

The anterior crucial ligament is attached below to the non-articular area of the upper surface of the head of the tibia behind the attachment of the anterior horn of the internal semilunar. It proceeds upwards, backwards, and outwards, to the back part of the inner surface of the external femoral condyle. The ligament is tight in extension and normally prevents hyper-extension and antero-posterior movement of the tibia. When the internal lateral ligament has been divided, the anterior crucial is tightened by external rotation of the tibia upon the femur.

The posterior crucial ligament is attached below to the back part of the non-articular area of the upper surface of the tibia and above to the anterior part of the external surface of the inner femoral condyle. The ligament is tight in extreme flexion of the knee and normally prevents displacement backwards of the tibia. It is also tightened by external rotation of the tibia and in full extension.

It is clear from what we have said that the characteristic signs of injury to the anterior crucial ligament are hyper-extension of the leg, with abnormal anterior-posterior mobility and abnormal power of rotation either of the femur inwards or of the tibia outwards. When, as frequently happens, the internal lateral ligament has been simultaneously damaged, lateral mobility in the outwards direction will be present. The patient usually complains of weakness with a feeling of insecurity of the limb. There may be a sensation of "giving-way" of the joint and occasional swelling but actual locking does not occur in uncomplicated cases.

Rupture of the posterior crucial ligament is a rarer lesion and rarely occurs alone, being usually associated with a lesion of the anterior crucial. The characteristic sign consists in the fact that the tibia can be displaced backwards when the knee is flexed. In some cases the tibial spine may be avulsed by the anterior crucial and in these cases there is usually a block to full extension of a firm bony nature. An X-ray settles the diagnosis by revealing the displaced bony fragment. In neglected cases the block to full extension persists and is associated with recurrent effusions.

Treatment of ruptured crucial requires a long period of immobilisation during which wasting and stiffness may be largely prevented by massage and electrical stimulation. In fractures of the tibial spine the bony block must be removed by manipulation or operation and a somewhat shorter period of immobilisation ordered.

Adhesions in the Knee-Joint.—May be intra-articular, in connection with the capsule, or entirely extra-capsular. They constitute a very large field and may occur after synovitis, whether traumatic or infective, or arthritis. They are very common after fractures into or in the vicinity of the knee-joint. The most obvious sign is a certain amount of limitation of movement and slight degrees are apt to be overlooked. Slight adhesions may give rise to a surprising amount of disability in the form of pain, synovia effusion, weakness, tenderness, muscular wasting, and a sensation of giving-way of the joint. With proper technique and attention to after-treatment the results of manipulation are often extremely satisfactory. A few general principles of the treatment of a knee with limitation of movement from this cause are as follows :—

(1) The sense of touch, attention to technique and after-treatment are probably even more necessary than mere physical strength, the use of extreme force is never necessary and may lead to fracture or injury to other important structures. In those cases in which the stiffness is so marked that extreme force would be necessary, open operation is in most cases to be preferred where feasible, or open operation combined with manipulation. Even if damage to adjacent structures could be ruled out of court, the severe action caused by the rupture of dense adhesions results

usually in a fresh stiffening of the joint and the result is disappointing.

(2) As a general rule the results of manipulation vary according to the degree and strength of the adhesions and the force necessary for their disruption, thus, the cases in which but little force has been necessary and in which adhesions are slight are attended with the best prognosis.

(3) In obstinate cases it is better to regain full movement by a series of manipulations at intervals.

(4) In cases of slight adhesions a series of rapid movements using a long leverage are indicated to rupture the adhesions. When the latter are of a denser nature movements of a slower and more deliberate nature, using a shorter leverage, are less liable to cause fracture.

(5) The patella must always be mobilised first as attempts to flex while the patella is fixed by adhesions may result in fracture of the latter.

(6) When movement has been restored by manipulation the joint must either immediately or within a few hours be again moved through the increased range and this movement subsequently kept up at regular intervals to ensure success.

(7) The frequent co-existence of a functional element must always be borne in mind and it is therefore very important to inspire confidence and keen co-operation in the patient.

(8) When movement, instead of being increased is actually lessened after manipulation, or if pain and reaction follow, it shows either that the case was an unsuitable one for manipulation or that unsuitable methods were used.

My time is now drawing to a close. It has only been possible to touch the fringe of a very large subject, but I sincerely hope that these cursory remarks may prove useful to those of you who so frequently encounter these puzzling cases in practice.

